



NOTES TUBERCULOSIS

MICROBE OVERVIEW

- Tuberculosis (AKA *Mycobacterium tuberculosis*) mycobacterium that primarily infects lungs but may infect any bodily organ/tissue
- Important properties
 - Curved rod shaped bacteria often wrapped together in cord-like formations
 - Obligate aerobe
 - Impervious to Gram staining due to waxy cell wall composed of fatty acids (e.g., mycolic acid)
- **Staining:** acid-fast stains like Ziehl-Neelsen, fluorescent stains like auramine/rhodamine
- Clumped colonies
- Distinctly slow growing (up to 6 weeks for visible growth)
- Grown on Lowenstein-Jensen media
- Resistant to weak disinfectants, can survive on dry surfaces for months
- Can avoid mucus traps, getting into deep airways (alveoli)

MYCOBACTERIUM TUBERCULOSIS

osms.it/mycobacterium-tuberculosis

PATHOLOGY & CAUSES

TYPES

Primary tuberculosis

Reactivation tuberculosis

- In about 5–10% cases of primary TB

Extrapulmonary tuberculosis

- May involve any organ (most commonly kidneys, meninges, lymph nodes, etc.)
- Systemic miliary tuberculosis

STAGING

- Transmitted by inhaling infectious aerosol droplets from individual with active TB (e.g. coughing, sneezing, speaking, etc.)
- TB enters lungs, gets phagocytized by macrophages → TB produces enzymes that inhibit lysosome and phagocytic vacuole

fusion → bacteria survives, proliferates, creates localized infection → primary tuberculosis development

- TB infiltrated macrophage fusion → Langhans giant cells
- Cell-mediated immunity activation → granuloma forms within infected area → caseous necrosis inside granuloma → Ghon focus
- Lymphatic dissemination of TB → lymph node caseation
- Ghon focus + involved lymph node → Ghon complex
- Ghon complex fibrosis, calcification → Ranke complex
- Primary infection resolution
 - Mycobacteria killed by immune system
 - Bacteria walled off in granuloma remains dormant but viable → latent tuberculosis with no further complications in immunocompetent

VISIT...

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individuals

- Compromised immune system → more caseous necrosis areas → **cavity formation** → reactivation tuberculosis

RISK FACTORS

- Immunocompromised states
 - HIV
 - Diabetes mellitus
 - Hematologic malignancy
 - Chronic lung disease (especially silicosis)
 - Malnutrition
 - Aging
- Substance abuse
 - Alcoholism
 - Injection drug users
- Close contact with individuals with active TB infection
 - Healthcare providers
 - Incarceration
- Lower-income, medically underprivileged countries
 - Recent immigrants from high-prevalence countries

COMPLICATIONS

- Bronchopneumonia
- Pneumothorax
- Extrapulmonary tuberculosis
 - Kidney → dysuria, pyelonephritis with sterile pyuria
 - Meninge → meningitis
 - Lumbar vertebrae → Pott disease
 - Liver and gallbladder → hepatitis, obstructive jaundice
 - Lymph nodes → cervical tuberculous lymphadenitis (scrofula)
 - Peritonitis
 - Pericarditis
- Systemic infection

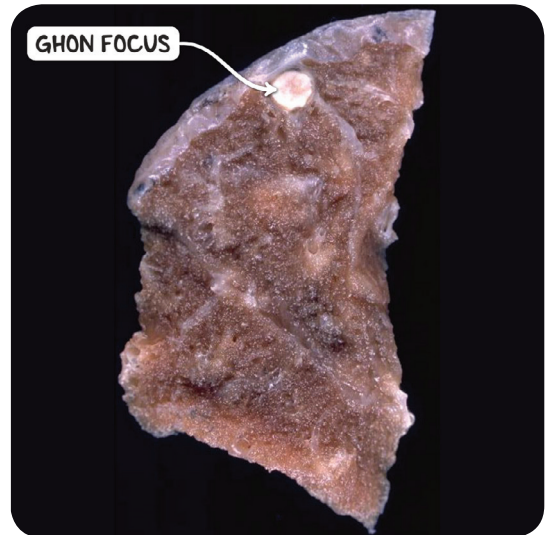


Figure 105.1 The gross pathological appearance of a Ghon focus.

SIGNS & SYMPTOMS

- Primary tuberculosis
 - Usually asymptomatic (90-95% of cases)
 - Mild flu-like illness
 - Rarely pleural effusion
- Reactivation tuberculosis
 - Constitutional symptoms (fever, chills, night sweats, fatigue, appetite loss, weight loss, pleuritic chest pain)
 - Cough (dry cough, prolonged cough producing purulent sputum, hemoptysis—suggesting advanced TB)
 - Crepitations during lung auscultation
- Extrapulmonary tuberculosis
 - Depending on affected organ/tissue
- Miliary (disseminated) tuberculosis
 - Can affect any organ (e.g. choroidal tubercles in eye, granulomas within organs)
 - Weight loss
 - Fever, chills
 - Dyspnea

DIAGNOSIS

DIAGNOSTIC IMAGING

Chest X-ray

- Used in PPD/IGRAs positive
- Ranke complex → sign of healed primary TB
- Cavities → active TB sign

LAB RESULTS

PPD intradermal skin test (tuberculin test)

- Screening test for people at high risk for TB
 - Tuberculin injection between dermal layers, induration area measurement within 48–72 hours
- Induration area $\geq 5\text{mm}$: positive in immunocompromised individuals, persons with primary TB radiographic evidence/ close contact with those with active TB
- Induration area $\geq 10\text{mm}$: positive in residents/immigrants from high-prevalence countries, children $>$ four years of age, high risk populations (e.g., medical employees)
- Induration area $\geq 15\text{mm}$: considered positive in individuals with no known risk factors
- Cannot be used for differentiation between active and latent TB
- PPD result interpretation
 - Positive → exposure evidence
 - False-positive → previously immunized with BCG vaccine
 - Negative → no exposure evidence
 - False-negative → sometimes seen in individuals with sarcoidosis, malnutrition, Hodgkin's lymphoma

Sputum testing

- Used for definitive diagnosis
- Staining, culture, PCR

OTHER DIAGNOSTICS

Interferon gamma release assays (IGRAs)

- Alternative for PPD
- Unlike PPD, doesn't show false-positive results in BCG vaccinated

Antibiotic resistance

- Multiple-drug-resistant TB
 - Resistant to isoniazid and rifampin
- Extensively drug-resistant TB
 - Resistant to both isoniazid and rifampin, any fluoroquinolone, at least one second-line drug



Figure 105.2 An X-ray image of the chest demonstrating diffuse interstitial granular densities in an individual with miliary tuberculosis.

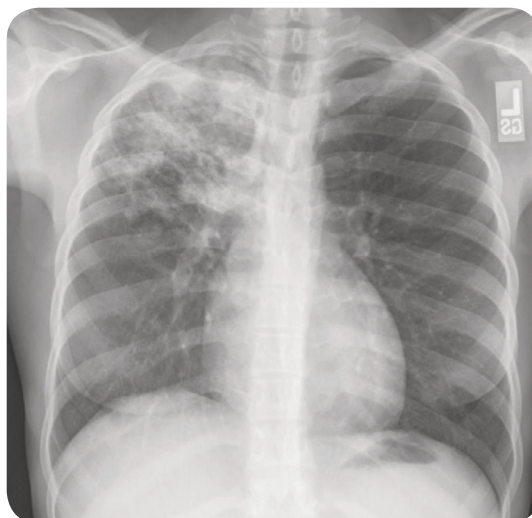


Figure 105.3 Multifocal patchy opacities in the right upper lobe of an individual who presented with night sweats, weight loss and persistent cough. The presenting symptoms and radiological appearance are consistent with pulmonary tuberculosis.

TREATMENT

MEDICATIONS

- Prophylactics
 - BCG vaccine (some countries)
- Latent TB
 - Isoniazid for 9 months
- Active TB
 - *First line anti-TB drugs: isoniazid, rifampin, pyrazinamide, ethambutol/streptomycin*
- Antibiotic resistance
 - For multiple-drug-resistant TB, treatment requires second-line drugs (amikacin, kanamycin, capreomycin)

OTHER INTERVENTIONS

- Active TB
 - Compulsory isolation (until sputum negative for TB)

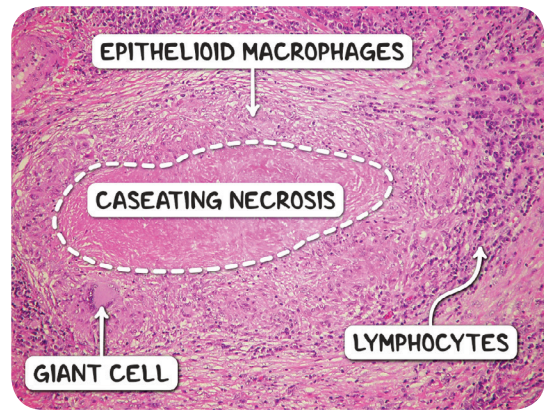


Figure 105.4 The histological appearance of a tuberculosis granuloma. The granuloma is formed of epithelioid macrophages and giant cells with a focus of caseating necrosis at the centre and a rim of lymphocytes at the periphery.